## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Horie et al (US 2001/0005137) (hereafter "Horie '137") in view of Horie et al (US 2002/0113596) (hereafter "Horie '596") and Tsukada et al (USP 5,250,168). Tsukada is being cited and relied on for the first time with this office action. Its use here was necessitated by the applicant's amendment to claim 1.

3. With respect to claim 1, Horie '137 discloses a potentiometric sensor device for measuring a pH value comprising a substrate comprising two electrodes positioned on the substrate, where the two electrodes are of a comb structure (par. 0019), and further discloses an evaluation circuit (i.e. pH meter) in communication with the electrodes where the evaluation circuit is configured to detect a degradation process of a motor oil based on the potentiometric response of the two electrodes. See par. 0009, 0010, and 0021. With respect to the use of thick film technology for constructing the electrodes, the determination of patentability for the claim is based on the product itself. Because the product of the claim is identical to the invention of Horie '137, the process from which it was made is the same as or obvious over the process utilized by Horie '137 (see *In re Thorpe*, 777 F.2d 695, 698). Horie'137 does not explicitly

disclose that the comb shaped electrodes are interdigital or that the evaluation circuit is disposed on the substrate. With respect to the interdigitation, Horie '596 disclosed an alternate configuration of comb shaped electrodes and taught interdigitating the electrodes to minimize the distance between the electrodes so as to improve the accuracy of the pH sensing probe. See fig. 1 and 19 and par. 0126. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to interdigitate the electrodes of Horie '137 as suggested by Horie '596 so as to minimize the distance between the electrodes and thereby maximize the accuracy of the pH oil probe. With respect to the location of the evaluation circuit, Tsukada teaches in an alternate ion sensor that the sensor circuitry 17 (i.e. evaluation circuit) can be disposed on the same substrate as the electrodes for the sensor probe. See fig. 2 and 8 and col. 4, l. 63 - col. 5, l. 12. Because Horie '596 already recognized that the circuitry 381 for the oil sensor can be located adjacent to the actual oil sensor (fig. 34 and par. 0174), it would have been obvious to one of ordinary skill in the art at the time the invention was being made to also utilize the substrate of Horie '137 that the electrodes were mounted to as a location for the evaluation circuit, as suggested by Tsukada, in order to facilitate the device integration and to minimize the number of substrates needed for the sensor.

4. With respect to claim 2, see Horie '596 par. 0123.

5. With respect to claim 3, Horie '596 show electrodes that are spaced at intervals around 100 and 200 μm (i.e. 0.1 and 0.2 mm) provided high accuracy pH sensing (par. 0126 and fig. 19). It would have been obvious to utilize a distance in the range of 160-200 μm for the sensing electrodes of Horie '137 because distances in that range appear to provide 97-98 % accuracy.

6. Claims 4-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Horie '137 in view of Horie '596 and Tsukada as applied to claim 3 above, and further in view of Tani et al (USP 5,904,987).

7. With respect to claims 4 and 5, Horie '137, Horie '596, and Tsukada set forth all the limitations of the claim, but did not explicitly recite the use of a glass ceramic as the substrate. Tani teaches that glass ceramic composites were a known alternative to materials such as alumina (one of the suggested substrates of Horie '137 (par. 0019)), and Tani further discloses that glass ceramic composites had the added advantage of being sinterable at lower temperatures. See col. 1, ll. 14-40. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Tani for the sensor device of Horie '137, Horie '596, and Tsukada because the substitution of one known substrate material for another requires only routine skill in the art. Moreover, because the substrate of Tani requires lower temperature sintering, the various electrodes of Horie '137 could have been deposited onto the substrate before firing thereby allowing the use of the technologies such screen printing onto ceramic green sheets for the construction of the sensor of Horie '137. With respect to the glass ceramic being in the form of a foil, the use of foils or tapes of ceramic materials requires only routine skill in the art. With respect to the material having high mechanical strength, absent a particular definition of the level of mechanical strength being sought, the presumption is that the glass ceramic materials of Tani meet the broadly defined high mechanical strength of the claims.

8. With respect to claim 6, see Horie '137 par. 0028.

9. Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Horie '137 in view of Horie '596, Tsukada, and Tani as applied to claim 6 above, and further in view of Kato et al (USP 5,320,735) and Carter et al (USP 5,126,034).

10. The references set forth all the limitations of the claims, but did not explicitly disclose that the two electrodes are made of silver and iridium oxide. In particular, although Horie '137 recognize the use of metal oxides as the pH sensitive material (par. 0028) and further recognized the use of Ag as a reference electrode when combined with AgCl (par. 0021), Horie '137 did not explicitly disclose the use of iridium dioxide as the sensitive metal oxide and didn't explicitly utilize one of its comb electrode as a Ag based reference electrode. With respect to the use of iridium dioxide, Kato teaches that that is a well known metal oxide with pH sensitivity (col. 4, ll. 52-66). It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Kato for the sensor device of Horie '137, Horie '596, Tsukada, and Tani because the substitution of one known metal oxide electrode for another requires only routine skill in the art. With respect to the use of Ag as a reference electrode, Carter like Horie '137 teaches of silver and silver halide, and Carter further discloses that an electrode of an interdigital comb may be silver/silver chloride (see column 3, lines 28 - 31). Because Carter demonstrates that a reference electrode constructed of Ag/AgCl can be constructed as an interdigitated electrode and because Carter discloses that Ag/AgCl is "especially preferred", it would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Carter and construct one of the comb electrodes of Horie '137 as a Ag reference electrode because a Ag/AgCl electrode would be a

more stable reference potential for the pH sensor. See fig. 2 and par. 0022 of Horie '137 where it states that its non-Ag/AgCl reference electrode is only "satisfactory".

11. Claims 9-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Horie '137 in view of Horie '596 and Tsukada as applied to claim 1 above, and further in view of Radford et al (USP 3,843,400).

12. The references set forth all the limitations of the claims, but the electrodes are not disclosed as being made from the paste compositions of claims 9 - 13.

13. Regarding claims 9 and 10, Radford teaches making electrodes from paste (see col. 5, ll. 30-35), wherein, in order to improve adhesion (see col. 2, ll. 17-20) between the electrodes and the substrate, the pastes include an inorganic material of 10% (see col. 5, l. 26).

14. Regarding claim 11, Radford teaches the inorganic material corresponds to the substrate (see col. 4, ll. 24 - 26 and col. 7, l. 13 - col. 8, l. 24).

15. Regarding claims 12 and 13, Radford teaches the pastes are made of a powder mixture of electrode material and inorganic material (see col. 7, ll. 30-35 and col. 5, ll. 25-28) and a carrier material (see col. 7, l. 35 - col. 8, l. 10). As taught in col. 7, l. 35 - col. 8, l. 10 there may be up to 30% solvent plus small amounts of other carrier substances, meaning that the amount of powder taught overlaps the 10% to 70% claimed. It would have been obvious to one of ordinary skill the art to have made the electrodes of Horie '137 in accordance with the teachings of Radford, because Radford explains in column 2, lines 16 - 20 that the electrodes adhere better to the underlying substrate.

16. Claims 14-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Horie '137 in view of Horie '596 and Tsukada as applied to claims 1 and 3 above, or Horie '137 in view of

Horie '596, Tsukada, and Tani as applied to claim 4 above and further in view of Ushizawa et al (USP 4,582,589) and/or Hobbs et al (USP 5,522,980).

17. With respect to the claims, the references set forth all the limitation of the claims, but did not explicitly disclose the presence of a hydrous layer on the two electrodes. Ushizawa teaches an alternate pH electrode and discloses that a layer 14 can be placed over a pH electrode so as to protect the electrode to protect the electrode from contamination from large and medium sized molecular weight compounds while still providing the desired hydrogen ion transport. See col. 3, ll. 7-19. One of the disclosed polymers is hydroxyethlyl methacrylate which is a known hydrophilic (i.e. hydrous) polymer. Hobbs teaches an alternate sensor having interdigitated electrodes and teaches that a porous protective layer constructed of polyimide can be utilized over the interdigitated electrodes to protect the electrodes. See fig. 2 and col. 5, ll. 47-51. Applicant evidences with claims 15 and 17 that polyimide is a hydrous polymer. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of either Ushizawa or Hobbs for the sensor device of Horie '137, Horie '596, and Tsukada so as to protect the electrodes from contamination or damage. With respect to the use of the polymer of Ushizawa over both of the electrodes of Horie '137, that would have been obvious because both of the electrodes would have been susceptible to contamination. Moreover, Hobbs already demonstrates that protective layers should be deposited over both of the electrodes of an interdigitated pair of electrodes.

18. With respect to Ushizawa and the use of polyimide or polyamide, Ushizawa disclosed no criticality for its choice of protective polymer. Moreover, the present invention appeared to establish no criticality for its choice of polyamides or polyimides (specification, p. 7, ll. 14-24).

It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize other known hydrous polymers for the protective layer of Ushizawa, including the use of polyamides or polyimides, because the substitution of one known polymer for another requires only routine skill in the art. Furthermore, Hobbs already demonstrated that polyimide is a known material useable for protective layers for sensor electrodes.

19. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Horie '137 in view of Horie '596 and Tsukada as applied to claim 1 above, and in further view of Hornberger (US 1,956,741).

20. The references set forth all the limitations of the claim, but did not explicitly state that the evaluation circuit is configured to normalize a pH measurement in response to different operating states of motor oil. The present specification gives different temperatures as an example of different operating states (see p. 8, ll. 4-6). Hornberger teaches compensator (R2) "to automatically compensate the electrode circuit for variations in the pH value due to temperature changes" (page 4, lines 56 - 60). It would have been obvious to one of ordinary skill in the art to have configured the evaluation circuit of Horie '137, Horie '596 and Tsukada to normalize a measurement in response to different temperatures as taught by Hornberger to achieve accurate results (see p. 4, ll. 56-60).

***Response to Arguments***

21. Applicant's arguments with respect to claims 1-20 appear to be based on the belief that the new limitation of claim 1 reads free of the relied on prior art. These arguments are moot in view of the new ground(s) of rejection.

***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to KAJ K. OLSEN whose telephone number is (571)272-1344. The examiner can normally be reached on M-F 5:30-2:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam X. Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/Kaj K Olsen/
Primary Examiner, Art Unit 1795
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